

Data User Guide

NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IMPACTS

Introduction

The NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IMPACTS dataset consists of rain rate, reflectivity, Doppler velocity, and other radar measurements obtained from the NPOL radar during the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign. The goal of IMPACTS was to provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution, examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands, and improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. The IMPACTS NPOL data are available from January 10, 2020 thru February 25, 2020. Zipped data files are in netCDF-3/CF format and contain corrected radar reflectivity, differential reflectivity, specific differential phase, differential phase, co-polar correlation, and Doppler velocity images.

Notice:

This dataset does not have continuous data.

Citation

Tokay, Ali, David B. Wolff, and Charanjit S. Pabla. 2020. NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IMPACTS [indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/IMPACTSNPOL/DATA101>

Keywords:

NASA, GHRC, IMPACTS, NPOL, S-band, Radar, RHI, PPI, precipitation, radar reflectivity, co-polar correlation, differential reflectivity, differential phase, spectrum width, doppler velocity, rain rate

Campaign

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS), funded by NASA's Earth Venture program, is the first comprehensive study of East Coast snowstorms in 30 years. IMPACTS will fly a complementary suite of remote sensing and in-situ instruments for three 6-week deployments (2020-2022) on NASA's ER-2 high-altitude aircraft and P-3 cloud-sampling aircraft. The first deployment began on January 17, 2020 and ended on March 1, 2020. IMPACTS samples U.S. East Coast winter storms using advanced radar, LiDAR, and microwave radiometer remote sensing instruments on the ER-2 and state-of-the-art microphysics probes and dropsonde capabilities on the P-3, augmented by ground-based radar and rawinsonde data, multiple NASA and NOAA satellites (including GPM, GOES-16, and other polar orbiting satellite systems), and computer simulations. IMPACTS addressed three specific objectives: (1) Provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution; (2) Examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands; and (3) Improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. More information is available from [NASA's Earth Science Project Office's IMPACTS field campaign webpage](https://espo.nasa.gov/impacts).

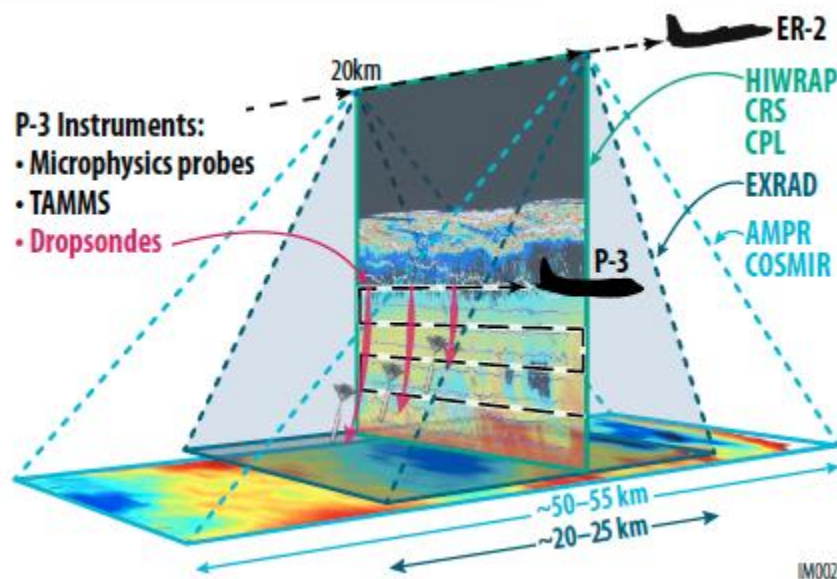


Figure 1: IMPACTS airborne instrument suite.
(Image Source: <https://espo.nasa.gov/impacts>)

Instrument Description

During the IMPACTS field campaign, the NASA S-Band Dual Polarimetric (NPOL) Doppler Radar was located at Lat: 38.263N, Lon: 75.342W. NPOL was developed by the research team at Wallops Flight Facility (WFF). This instrument is a fully transportable and self-contained S-band (10 cm), scanning dual-polarimetric Doppler research radar that takes

accurate volumetric measurements of precipitation including rainfall rate, particle size distributions, water contents and precipitation type. Two different scan types are used: Plan Position Indicator (PPI) - 360 degree sweep of the antenna and Range Height Indicator (RHI) - scans pointing at a specific azimuth with the antenna tilted upward to get vertical profile information. The scanning strategy emphasized vertical structure sampling via RHI and narrow sector-volume data collections, as well as frequent 3-minute full PPI rain scans for rain mapping. More information about the NPOL Doppler radar is available at the [Precipitation Measurement Missions NPOL website](#).

The NPOL radar scans a section of the atmosphere while also transmitting pulses in two directions (horizontal and vertical) and returns 3D images; the image data can be used to discern size, shape, and distribution of raindrops in clouds. The data aids scientists in better understanding the physics of rainfall.



Figure 2: Image of the NPOL Doppler radar
(Image Source: [Precipitation Measurement Missions NPOL website](#))

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Data Characteristics

The NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IMPACTS data are available in netCDF-3/CF format at a L1B data processing level. More information about the NASA data processing levels are available [here](#). Information needed to read UF files with IDL is available at the [GHRC](#).

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	NASA S-Band Dual Polarimetric (NPOL) Doppler radar
Spatial Coverage	N: 39.476, S: 37.049, E: -73.796, W: -76.887 (United States east coast)
Spatial Resolution	125 m - 300 m
Temporal Coverage	January 10, 2020 - February 25, 2020
Temporal Resolution	Minutes -< hours
Parameter	Radar reflectivity, co-polar correlation, Doppler velocity, rain rate
Version	1
Processing Level	1B

File Naming Convention

The NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IMPACTS dataset consists of zipped data files in netCDF-3/CF format with the file naming conventions shown below.

Data files: impacts_NPOL1_YYYY_MMDD_hhmmss_[ppi|rhi|qvp].cf.gz

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
ss	Two-digit second in UTC
.cf.gz	Zipped data files in netCDF-3/CF format
[ppi rhi qvp]	ppi: Plan Position Indicator mode rhi: Range Height Indicator mode Qvp: Quasi-Vertical Profiles

Data Format and Parameters

The NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IMPACTS data consists of radar reflectivity, Doppler velocity, rain rate, and other radar-related direct and derived

parameters. These files are in netCDF-3/CF format. Table 3 describes the acronym and units for each parameter.

Table 3: Data Fields

Parameter	Variable	Unit
Radar Reflectivity	ZZ	dBz
Corrected Radar Reflectivity	CZ	dBz
Co-polar Correlation	RH	-
Differential Reflectivity	DR	dB
Differential Phase	PH	degrees
Specific Differential Phase	KD	degrees /km
Spectrum Width	SW	m/s
Doppler Velocity	VR	m/s
Hydrometeor Identification	FH	-
Normalized Intercept Parameter (DM)	NW	-
Median Volume Diameter	DM	mm
DROPS2 Rain Rate	RR	mm/h
Pol ZR Rain Rate	RP	mm/h
Cifelli 2002 Rain Rate	RC	mm/h
Hydrometeor Class	HC	
Altitude	altitude	m
Azimuth	azimuth	degrees
Elevation angle	elevation	degrees
Fixed beam angle	fixed_angle	degrees
Frequency	frequency	1/s
Instrument type: Radar	instrument_type	-
Latitude	latitude	Degrees North
Longitude	longitude	Degrees East
Unambiguous Doppler Velocity	nyquist_velocity	m/s
Pulse Repetition Time	prt	s
Transmitter pulse width	pulse_width	s
Half power radar beam width h channel	radar_beam_width_h	degrees
Half power radar beam width v channel	radar_beam_width_v	degrees
Range to measurement volume	range	m
Number of ray gates	ray_n_gates	-
Ray start index	ray_start_index	-
Antenna angle scan rate	scan_rate	degrees/s
Index of last ray in sweep	sweep_end_ray_index	-
Scan mode for sweep	sweep_mode	-

Sweep index number 0 based	sweep_index_number_0_based	-
Index of first ray in sweep	sweep_start_ray_index	-
Time in seconds since volume start	time	s
Data volume end time in UTC	time_coverage_end	UTC
Data volume start time in UTC	time_coverage_start	UTC
Unambiguous range	unambiguous_range	m
Data volume index number	volume_number	-

Algorithm and Quality Assessment

The team used an algorithm that uses quality controlled radar data and is based on dual polarization parameters that are both modular and physically based. This helps to determine if an echo is precipitating. The Dual Polarization Quality Control (DPQC) algorithm can be applied to PPI and RHI scan types to allow users to easily view and manipulate the data. More detailed information about the DPQC algorithm is available in Pippitt et al., 2013. The NASA NPOL Doppler Radar calibrates as it is collecting data. More information about the calibration process and data quality can be found in [Chandrasekar et al., 2008](#).

Software

These NPOL IMPACTS data files are in netCDF-3/CF format. No special software is needed to read these data files; however, [Panoply](#) is an easy-to-use free tool for reading and visualizing the data within these netCDF-3/CF files.

Known Issues or Missing Data

This dataset does not have continuous data.

References

Chandrasekar, V. A., A. Hou, E. Smith, V. N. Bringi, S. A. Rutledge, E. Gorgucci, W. A. Petersen, and G. S. Jackson (2008): Potential Role of Dual-Polarization Radar in the Validation of Satellite Precipitation Measurements, *BAMS*, August 2008, 1127-1145. doi: <https://doi.org/10.1175/2008BAMS2177.1>

Pippitt, J. L., D. A. Marks, and D. B. Wolff (2013): Dual Polarimetric Quality Control for NASA's Global Precipitation Measurement (GPM) Mission Ground Validation Program.

Related Data

All data from other instruments collected during the IMPACTS field campaign are related to this dataset. Other IMPACTS campaign data can be located using the GHRC HyDRO 2.0 search tool.

In addition, other related data used the NPOL instrument in previous GPM Ground Validation, CAMEX-4, and NAMMA field campaigns. The following datasets contain NPOL data:

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar **OLYMPEX**
(<http://dx.doi.org/10.5067/GPMGV/OLYMPEX/NPOL/DATA301>)

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar **IFloodS V2**
(<http://dx.doi.org/10.5067/GPMGV/IFLOODS/NPOL/DATA102>)

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar **IPHEX**
(<http://dx.doi.org/10.5067/GPMGV/IPHEX/NPOL/DATA101>)

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar **MC3E**
(<http://dx.doi.org/10.5067/GPMGV/MC3E/NPOL/DATA101>)

CAMEX-4 NASA Portable S-Band Multiparameter WX Research Radar
(<http://dx.doi.org/10.5067/CAMEX-4/SBAND/DATA101>)

NAMMA NASA Polarimetric Doppler Weather Radar (NPOL)
(<http://dx.doi.org/10.5067/NAMMA/NPOL/DATA101>)

Contact Information

To order these data or for further information, please contact:

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Huntsville, AL 35805

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E-mail: support-ghrc@earthdata.nasa.gov

Web: <https://ghrc.nsstc.nasa.gov/>